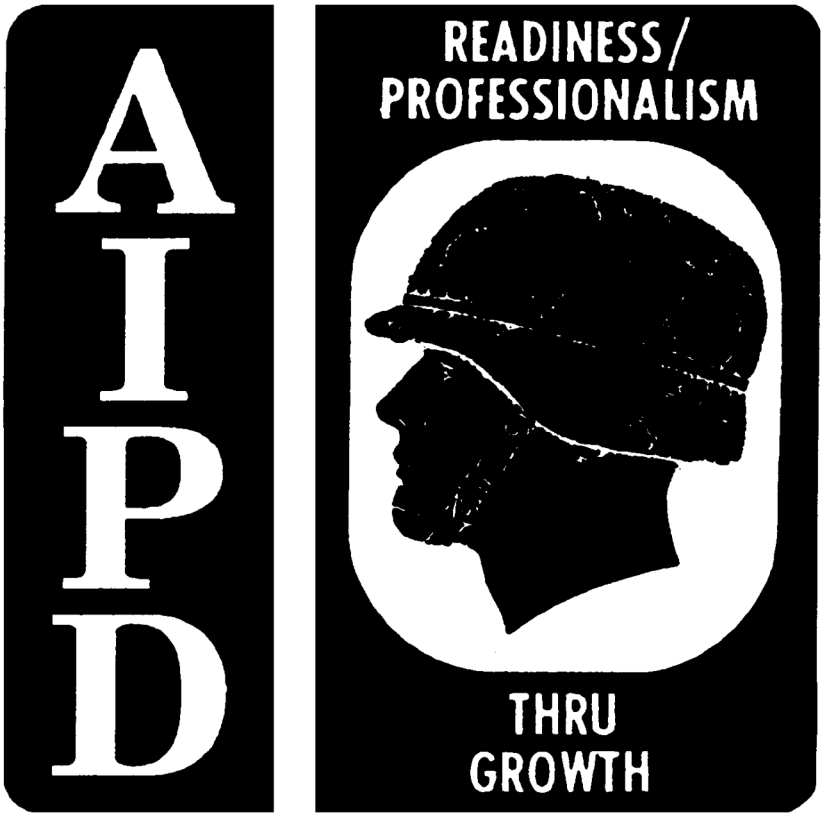
SUBCOURSE
MM 0099

EDITION
A

BASIC MATHEMATICS



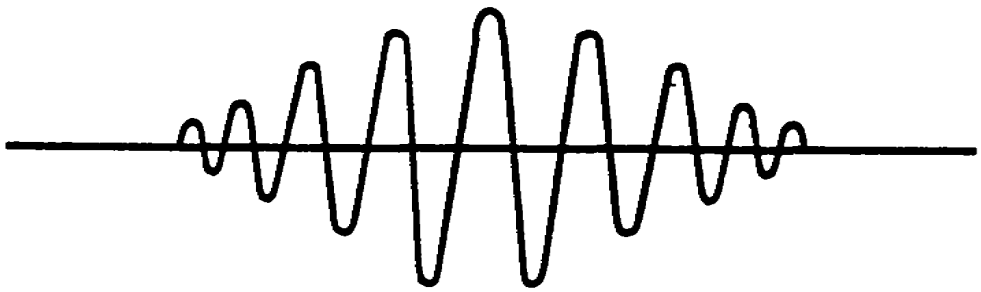
THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT

ARMY CORRESPONDENCE COURSE PROGRAM

Notice to Students

Use the Ordnance Training Division website,
http://www.cascom.army.mil/ordnance/,
to submit your questions, comments, and suggestions
regarding Ordnance and Missile & Munitions
subcourse content.

If you have access to a computer with Internet capability and can receive e-mail, we recommend that you use this means to communicate with our subject matter experts. Even if you're not able to receive e-mail, we encourage you to submit content inquiries electronically. Simply include a commercial or DSN phone number and/or address on the form provided. Also, be sure to check the Frequently Asked Questions file at the site before posting your inquiry.



3 CREDIT HOURS
REVIEWED: 1988

SECTION 1

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REVIEWED AND REPRINTED WITH MINOR REVISIONS JAN 76.

OBJECTIVES

As a result of taking this program of BASIC MATHEMATICS, you must be able to:

1. Use addition up to seven digits in solving electrical circuit problems, to include the carrying of digits.

2. Use subtraction up to seven digits in solving electrical circuit problems.

3. (Having proficiency in the multiplication table up to the 9x9 level) Use multiplication in solving electrical circuit problems.

4. Use long division in solving electrical circuit problems.

5. Use fractions in solving common electrical circuit problems.

6. Use decimals in solving common electrical circuit problems.

7. (With the aid of references)

   a. Identify these metric prefixes: mega, milli, kilo, micro, and micro-micro.

   b. Determine the value of the metric prefixes.

   c. Replace the metric prefixes with the proper symbols.

   d. Convert metric prefixes into their larger or smaller equivalents. For example: 1 kilovolt equals 1,000 volts.

8. Calculate square root commonly found in radio formulas.

PLEASE NOTE

Proponency for subcourse has changed from Signal (SS) to Missile & Munitions (MM).

HOW TO USE THIS BOOK

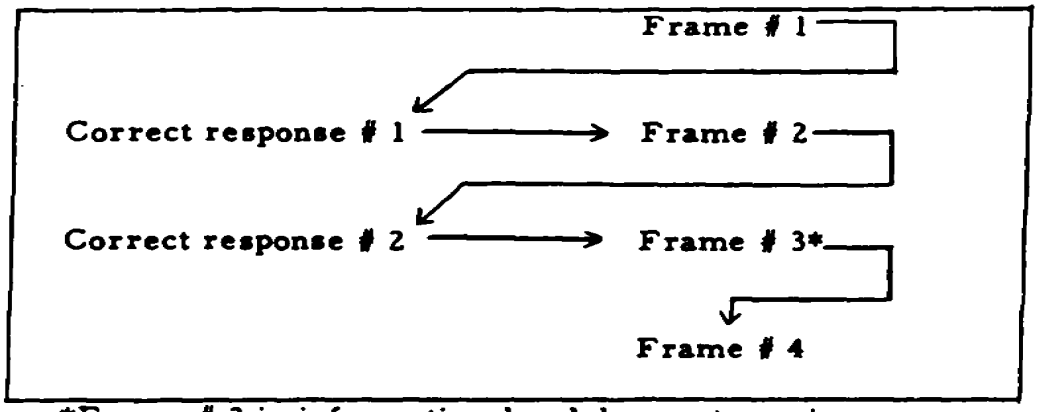
This is a self-instructional programmed course designed to help you review BASIC MATHEMATICS.

As you go through this book you will observe that it is systematically arranged in small simple learning steps called frames.

Because the purpose is to teach rather than merely present information, a single point may be repeated several times in different ways. What may seem to you like needless repetition in any other kind of reading is done here to reinforce learning.

SECTION 1

Each individual instructional unit or bit of information is called a frame. Each frame requires you to DO something: read the frame as informational, solve a problem, fill in a box, select an alternate, or write a phrase. Immediately thereafter, if the frame was not informational, (in the box below and to the left of the next frame) you will find the correct response and can compare your answer to it. For example:



***Frame # 3 is informational and does not require a response.**

If you were right, your response is immediately confirmed and the point you learned is thus reinforced. If you did not respond correctly you discover this immediately and learn what was the correct response. When you learn the correct response you can go ahead and build up your knowledge slowly but surely.

You will not have any other teacher for this material. This text is your teacher. Rely on it. It has been tested and proved an effective teacher. To get the best instruction, however, do not cheat by peeking ahead at the correct response. You are deceiving only yourself. Make an honest effort to do what is expected, and then compare your answer with the correct response.

Since this is a review subject, you are expected to know some areas of knowledge herein. We have built in certain frames to check this knowledge and save you the task of studying frames on subject matter you already know. If you answer these diagnostic frames correctly, you will be told TO SKIP AHEAD A CERTAIN NUMBER OF FRAMES. Be sure to do this so that you will be able to complete the text within the allotted training time.

***** IMPORTANT NOTICE *****

THE PASSING SCORE FOR ALL ACCP MATERIAL IS NOW 70%.

PLEASE DISREGARD ALL REFERENCES TO THE 75% REQUIREMENT.

GRAPHIC CHART OF MATH TERMS

Addition

247 ← Addends
+82 ←
329 ← Sum

Subtraction

365 ← Minuend
-39 ← Subtrahend
326 ← Difference or remainder

Multiplication

163 ← Multiplicand
x2 ← Multiplier
336 ← Product

Division

204 ← Quotient
Divisor → 23/4692 ← Dividend

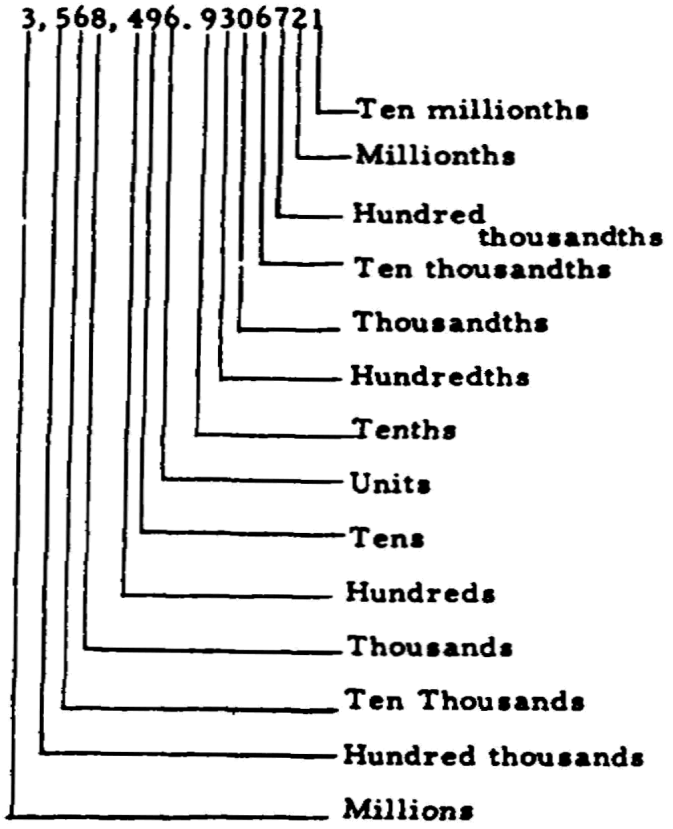
Fractions

1 ← Numerator
4 ← Denominator

Square Root

1 2 ← Root
$\sqrt{144}$ ← Radicand

A number by columns



Before proceeding with the required material, we want you to know that there are addition, subtraction, multiplication, division, and squares and square root tables at the end of this book. If you feel you need a quick refresher before proceeding with the frames, please check these tables.

We teach one method of mathematics, but there are many other methods too. You may use our method or your own method as long as you obtain correct results.

Okay, ready? Begin.

ADDITION

	(1) To review addition, do the following problems: 1,286 + 63 = 279,832 + 23,897 =
(1) $\begin{array}{r} 1,286 \\ +63 \\ \hline 1,349 \end{array}$ $\begin{array}{r} 279,832 \\ +23,897 \\ \hline 303,729 \end{array}$	

(2)

Now let's try SUBTRACTION.

$$\begin{array}{r} 1,000,002 \\ -\ 99,999 \\ \hline **** \end{array}$$

****Note - whenever this symbol **** is used DO NOT WORK THE PROBLEM because this is simply a sample problem for explanation purposes.

Before finding the difference for the above problem, we first must borrow 10 from the tens column so that we can subtract 9 from a number that is either equal to or larger than it. (In this example, we have to go left all the way to the millions column to get the 10.)

Step 1

$$\begin{array}{r} 1,000,002 \\ -\ 99,999 \\ \hline ? \end{array}$$

Step 2

$$\begin{array}{r} 1,000,002 \\ -\ 99,999 \\ \hline 900,003 \end{array}$$

(3) Let's practice:

800,701	56, 002
- 692	- 9,007

(3)

$$\begin{array}{r} 800,701 \\ -\ 692 \\ \hline 800,009 \end{array}$$

$$\begin{array}{r} 56,002 \\ -9,007 \\ \hline 46,995 \end{array}$$

(4)

1,007,802	7,008,324
- 8,933	- 989,655

(4)

$$\begin{array}{r} 1,007,882 \\ -\quad 8,933 \\ \hline 998,869 \end{array}$$

$$\begin{array}{r} 7,008,324 \\ -\ 989,655 \\ \hline 6,018,669 \end{array}$$

(5)

To review: 30 - 10 + 6 =

(5)

$$26$$

$$\begin{array}{rr} 30 & 20 \\ -10 & +6 \\ \hline 20 & 26 \end{array}$$

(6)

10 + 7 - 8=

MULTIPLICATION

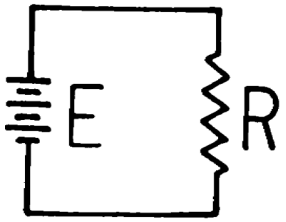
(6)

$$\begin{array}{r} 9 \\ \hline \end{array}$$

$$\begin{array}{r} 10 \\ +7 \\ \hline 17 \end{array} \qquad \begin{array}{r} 17 \\ -8 \\ \hline 9 \end{array}$$

(7)

Now MULTIPLICATION:



E = I x R

R has a value of 4 ohms and I has a value of 3 amperes.

The value of E is _____ volts.

(7)

12

I x R = E

3 x4 = 12

(8)

9 x 0 x 6=

(8)

0

IF YOU DID NOT ARRIVE AT THE CORRECT ANSWERS, REVIEW THE MULTIPLICATION TABLE AT THE END OF THIS BOOK BEFORE PROCEEDING TO THE NEXT FRAME.

(9)

6 x 4 x 3=

(9)

72

(10)

Sometimes to avoid confusion, a complicated expression must be inclosed in parentheses ( ), brackets [ ], or braces { }.

When multiplying quantities containing parentheses, brackets, or braces, you first complete the operation required within the parentheses (brackets or braces) and then multiply the quantities. For example: [4 + 7 + 2] [5 x 3] equals

[13] [15] or 13 x 15. 13 x 15 = 195.

To practice:

(2) (4) (3) =

(10) 24	(11) (200) (6) (7) =
(11) 8,400	(12) (50) (0) (2) =
(12) 0	(13) (4 x 3) (2 + 5) =
(13) 84 (4 x 3) (2 + 5) = (12) (7) = 84	(14) (6 + 0) (5 - 1) =

DIVISION

(14)

(6) (4) = 24

(15)

Good, now let's try DIVISION:

$5\overline{)525}$

(15)

$$\begin{array}{r} 105 \\ 5\overline{)525} \\ \underline{5} \\ 25 \\ \underline{25} \\ \end{array}$$

(16)

96/16 =

(16)

96/16 = 6

$$\begin{array}{r} 6 \\ 16\overline{)96} \\ \underline{96} \end{array}$$

(17)

Well done. Now let's try some harder problems.

25876 ÷ 27 =

33682 ÷ 876 =

(17)

958 10/27, 38 197/438

```
      958 10/27
27 ) 25876
     243
      157
      135
       226
       216
        10
```

```
        38 394/876 197/438
876 ) 33682
      2628
       7402
       7008
        394
```

(18)

$$\frac{20 + 5}{3 + 2} =$$

(Complete the required operation on the numerator. Then do what is required on the denominator.)

IF YOU FEEL YOU NEED MORE PRACTICE, DO THE REMAINING FRAMES ON DIVISION; OTHERWISE, SKIP TO FRAME NUMBER 24.

(18)

5

$$\frac{20 + 5}{3 + 2} = \frac{25}{5} = 5$$

(19)

$$\frac{40 - 4}{12 - 9} =$$

(19)

12

$$\frac{40 - 4}{12 - 9} = \frac{36}{3} = 12$$

(20)

$$\frac{4 \times 9 \times 3}{2 \times 6 \times 9} =$$

(20)

1

$$\frac{4 \times 9 \times 3}{2 \times 6 \times 9} = \frac{108}{108} = 1$$

(21)

$$\frac{(3 \times 5) + 3}{(2 \times 6) + 8} =$$

(21)

9/10

$$\frac{(3 \times 5) + 3}{(2 \times 6) + 8} = \frac{(15) + 3}{(12) + 8} =$$

$$\frac{18}{20} = \frac{9}{10}$$

(22)

$$\frac{2 \times 5 \times 8}{(7 - 3)(6 - 4)} =$$

(22)

10

$$\frac{2 \times 5 \times 8}{(7 - 3)(6 - 4)} =$$

$$\frac{80}{(4)(2)} = \frac{80}{8} = 10$$

(23)

$$\frac{(20 + 6)(4 - 2)}{(16 - 3)(4)} =$$

(23)
1

$$\frac{(20 + 6)(4 - 2)}{(16 - 3)(4)} =$$

$$\frac{(26)(2)}{(13)(4)} = \frac{52}{52} = 1$$

D I A F G R N A O M S E T I C S	(24) Very good. Now let's get into something a little more difficult, FRACTIONS. To practice: 5/6 + 3/8 + 2/5 =

(24) 1 73/120

Solution: 6 X 8 X 5 = 240

240 ÷ 6 40 240 ÷ 8 = 30 240 ÷ 5 = 48

40 X 5 = 200 30 X 3 = 90 48 X 2 = 96

200/240 + 90/240 + 96/240 = 386/240 = 1 146/240 = 1 73/120

IF YOU ANSWERED THIS PROBLEM CORRECTLY SKIP TO FRAME NUMBER 48; OTHERWISE, BEGIN WITH THE NEXT FRAME.

	(25) 1/4 - 1/2 **** 4 and 2 are called DENOMINATORS The bottom part of a fraction is called the _____.
(25) denominator	(26) 1/4 ÷ 1/2 = * 1 and 1 are the numerators. The upper part of a fraction is called a _____.

(26) numerator	(27) Fractions which can be REDUCED to a whole number should be reduced. To REDUCE a fraction to a whole number, divide the denominator into the numerator. 9/3 = 3 To practice: 8/4 =
(27) 2	(28) Any fraction greater than 1 can be reduced either to a whole number or a mixed number. A MIXED NUMBER contains both a whole number and a fraction. Some fractions can be reduced to a mixed number. To obtain a mixed number, divide the denominator into the numerator. 10/3 = 3 1/3 To practice: 22/7 =
(28) 3 1/7	(29) Fractions whose numerator and denominator are divisible by the same digit can be reduced by dividing both the numerator and denominator by this digit. THIS DOES NOT CHANGE THE VALUE OF THE FRACTION! 16/32 = ? 16/32 = 1/2 The numerator and the denominator are divisible by 2, 4, 8, or 16. Dividing by 16 will give you the lowest equivalent fraction. To practice: 24/72 =

(29) 1/3	(30) To review the statement that reducing a fraction does NOT change its value: 16/32 has the same value as 8/16 or as 4/8 or 16/32 = 8/16 = 4/8 = 1/2 Remember to reduce all fractions to their LOWEST terms.
	(31) 1/4 + 1/2 = **** In order to add fractions, you must find a number into which the denominators will divide. This is called a COMMON DENOMINATOR. The number into which the denominators of all fractions to be added will divide is the _____ _____.
(31) 1/4 + 1/2 = **** common denominator	(32) To find the common denominator, we try the inspection method first. By inspecting the problem, we notice that there are many numbers (such as 4, 8, 16, 4000, etc.) into which both denominators will divide. However, we want the smallest of these numbers, to simplify working the problem. This number, called the lowest common denominator or l.c.d., is _____.

(32) 4	(33) 1/4 + 1/2 = **** You wish to convert 1/2 into an equivalent fraction with a denominator of 4. To do so you divide 4 by 2 and arrive at an answer of 2. Since the denominator must be multiplied by 2 to get four, the numerator must also be multiplied by _____ to keep the fraction equivalent.
(33) 2	(34) 1/2 x 2/2 = 1/2 x 2/2 = 2/4 1/4 + 2/4 = (Finish working the problem)
(34) 3/4 1/4 + 2/4 = 3/4	(35) 3/4 is an example of a PROPER FRACTION--one whose value is less than unity (Unity = 1). A fraction whose value is less than unity is called a _____ fraction.

(35) proper	(36) 257/120 is an example of an IMPROPER FRACTION --one whose value is greater than unity. A fraction whose value is greater than unity is a (an) _____ fraction.
(36) improper	(37) Improper fractions can not be left in this unfinished state (257/120) but must be changed to a mixed number--one in which we have both a whole number and a fraction. A mixed number can be obtained by dividing the numerator by the denominator. A mixed number of 257/120 would be _____.
(37) 2 17/120 $120\overline{)257}\ 2\ 17/120$ 240 17	(38) When one has both a whole number and a fraction, one has a _____ _____.

(38) mixed number	(39) Fine. Now let's tackle something a little bit harder. If you cannot secure the lowest common denominator (l.c.d.) which is divisible into all denominators, multiply the denominators and the product will be the l.c.d. The l.c.d. of 2/3 + 4/7 + 1/2 is 3 x 7 x 2 = 42
	(40) 2/3 + 4/7 + 1/2 = **** In order to add these fractions we must change them so all the denominators are the same. To change these fractions, divide the denominator into the l.c.d. and multiply the numerator and denominator by this number. For example: 2/3, first divide 3 into 42, which equals 14. Multiply the fraction 2/3 x 14/14 = 28/42 4/7, divide 7 into 42 which is 6. Multiply 4/7 x 6/6 = 24/42. 1/2, divide 2 into 42 which is 21. Multiply 1/2 x 21/21 = 21/42. 2/3 + 4/7 + 1/2 = 28/42 + 24/42 + 21/42 28/42 + 24/42 + 21/42 = 73/42 = 1 31/42

	(41) Let's practice: 5/6 + 3/5 + 1/4 =
(41) 1 41/60 6 x 5 x 4 = 120 120 ÷ 6 = 20, 120 ÷ 5 = 24, 120 ÷ 4 = 30 20 x 5 = 100, 24 x 3 = 72, 30 x 1 = 30 100/120 + 72/120+ 30/120 = 202/120 = 1 82/120 = 1 41/60	(42) 2/3 + 3/5 + 1/7 =

(42)

1 43/105

3 x 5 x 7 = 105

105 ÷ 3 = 35, 105 ÷ 5 = 21, 105 ÷ 7 = 15

35 x 2 = 70, 21 x 3 = 63, 15 x 1 = 15

70/105 + 63/105 + 15/105 = 148/105 = 1 43/105

(43)

1/3 + 5/8 + 4/5 =

(43)

1 91/120

3 x 8 x 5 = 120

120 ÷ 3 = 40, 120 ÷ 8 = 15, 120 ÷ 5 = 24

40 x 1 = 40, 15 x 5 = 75, 24 x 4 = 96

40/120 + 75/120 + 96/120 = 211/120 = 1 91/120

(44)

5/9 + 4/7 + 2/5 =

IF YOU GOT THE LAST THREE (3) PROBLEMS CORRECT AND DO NOT FEEL THAT YOU NEED ADDITIONAL PRACTICE, SKIP TO FRAME NUMBER 48; OTHERWISE, CONTINUE WITH THE NEXT FRAME.

(44)

1 166/315

9 x 7 x 5 = 315

315 ÷ 9 = 35, 315 ÷ 7 = 45 315 ÷ 5 = 63

35 x 5 = 175, 45 x 4 = 180 63 x 2 = 126

175/315 + 180/315 + 126/315 = 481/315 = 1 166/315

(45)

1/8 + 3/7+ 2/3 =

(45)

1 37/168

8 x 7 x 3 = 168

168 ÷ 8 = 21, 168 ÷ 7 = 24, 168 ÷ 3 = 56

21 x 1 = 21, 24 x 3 = 72, 56 x 2 = 112

21/168 + 72/168 + 112/168 = 205/168 = 1 37/168

IF YOU GOT THE LAST TWO (2) FRAMES CORRECT AND THINK YOU UNDERSTAND HOW TO DO THESE, SKIP TO FRAME NUMBER 48. IF NOT, CONTINUE.

(46) 2/3 + 1/2 + 3/8 =

(46)

1 13/24

3 x 2 x 8 = 48

48 ÷ 3 = 16, 48 ÷ 2 = 24, 48 ÷ 8 = 6

16 x 2 = 32, 24 x 1 = 24, 6 x 3 = 18

32/48 + 24/48 + 18/48 = 74/48 = 1 26/48 = 1 13/24

(47)

3/4 + 1/6 + 3/5 =

(47)

1 31/60

4 x 6 x 5 . 120

120 ÷ 4 = 30 120 ÷ 6 = 20 120 ÷ 5 = 24

30 x 3 = 90 20 x 1 = 20 24 x 3 = 72

90/120 + 20/120 + 72/120 = 182/120 = 1 62/120 = 1 31/60

(48)
Well done. Now let's try SUBTRACTION OF FRACTIONS.

Subtract 1/8 from 2/7.

DIAGNOSTIC FRAME

(48)
9/56

2/7 - 1/8 =

16/56 - 7/56 =

16/56 - 7/56 = 9/56

IF YOU ANSWERED THE PROBLEM CORRECTLY, SKIP TO FRAME NUMBER 62; OTHERWISE, BEGIN WITH THE NEXT FRAME.

	(49) 3/4 - 1/2 =**** A number into which the denominators will divide is called the _____ _____.
(49) common denominator	(50) 3/4 - 1/2 = **** By the inspection method, you can see that the perfect dividend for both denominators - in other words the smallest number in which both denominators will divide evenly - will be the number _____.

(50) 4	(51) 3/4 - 1/2 = **** To subtract fractions you must make the denominators the same. The equivalent fraction of 1/2 is_____.
(51) 2/4 3/4 - 1/2 x 2/2 = 3/4-2/4 2/4 = 1/2	(52) To practice: 3/4 - 2/4 =
(52) 1/4 We subtract the numerator after the subtraction sign and carry over the l.c.d.	(53) 1/4 is an example of a _____ fraction.
(53) proper	(54) A proper fraction is defined as one whose value is _____ than unity.

(54) less	(55) 2/5 - 1/3 = **** To subtract fractions whose denominators do not have a common dividend, you must multiply the denominators and the product is your l.c.d. In the above problem, 15 is the l.c.d. (5 x 3 = 15). 4/7 - 3/4 = **** The l.c.d. is _____.
(55) 28	(56) 2/5 - 1/3 = **** 2/5 - 1/3 can be expressed in EQUIVALENT FRACTIONS BY _____ - _____.
(56) 6/15 - 5/15 2/5 x 3/3 - 1/3 x 5/5 = 6/15 - 5/15	(57) To practice: 6/15 - 5/15 =
(57) 1/15 We subtract the numerator after the subtraction sign and carry over the l.c.d.	(58) 5/7 - 1/3 =

(58)
8/21

5/7 - 1/3 =
15/21 - 7/21 =
15/21 - 7/21 = 8/21

(59)
20/42 - 10/21 =

(59)
0

20/42 - 10/21 =
20/14 - 20/42 =
20/42 - 20/42 = 0

(60)
2/3 - 2/9 =

9/16 - 3/8 =

(60)
4/9, 3/16

2/3 - 2/9 =
6/9 - 2/9 =
6/9 - 2/9 = 4/9

9/16 - 3/8 =
9/16 - 6/16 =
9/16 - 6/16 = 3/16

IF YOU ANSWERED THE LAST FOUR (4) FRAMES CORRECTLY AND DO NOT FEEL THE NEED FOR ADDITIONAL PRACTICE, SKIP THE NEXT FRAME; OTHERWISE, DO THE NEXT FRAME.

(61)
3/7 - 1/6 =

2/3 - 7/32 =

(61)
11/42, 43/96

3/7 - 1/6 =
18/42 - 7/42 =
18/ 42 - 7/42 = 11/42

2/3 - 7/32 =
64/96 - 21/96 =
64/96 - 21/96 = 43/96

IF YOU FAILED TO REACH THE PROPER NUMERATORS AND DENOMINATORS, RETURN TO THE BEGINNING PART OF THIS SECTION FOR A REVIEW.

DIAGNOSTIC FRAME

(62)

Fine. MULTIPLICATION OF FRACTIONS should not be too hard for you.

Multiply 4/3 times 2/5.

(62)

8/15

4/3 x 2/5 =

$$\frac{4 \times 2}{3 \times 5} = \frac{8}{15}$$

IF YOU ANSWERED THE PROBLEM CORRECTLY, SKIP TO FRAME NUMBER 72; OTHERWISE, BEGIN WITH THE NEXT FRAME.

	(63) To receive a product in fraction form, we have to multiply one numerator by another and one denominator by another. 2/3 x 1/6 = ? $\frac{2 \times 1}{3 \times 6} = \frac{2}{18}$
	(64) 2/18 can be reduced to _____.
(64) 2/18 = 1/9 (2 goes into both the numerator and the denominator.)	(65) The product of a fraction must be _____ whenever possible. 2/18 can be reduced to 1/9 by dividing the numerator and the denominator by _____.

(65)
reduced, 2

(66)
As you notice, the same number must be able to go into both the numerator and the denominator at least _____.
(number of times)

If both parts of the fraction can be divided by a larger number, use the largest number possible, because then you will _____ the fraction to its lowest or simplest form.

(66)
once, reduce

(67)
Now to practice.

3/4 x 6/7 =

(67)
9/14

3/4 x 6/7 =

$$\frac{3 \times 6}{4 \times 7} = \frac{18}{28} = \frac{9}{14}$$

(68)
18/28 can be reduced by dividing _____
(number)
into the numerator and the denominator.

(68)
2

(69)
To practice:

2/3 x 6/5 =

(69)
4/5

2/3 x 6/5 =

$$\frac{2 \times 6}{3 \times 5} = \frac{12}{15} = \frac{4}{5}$$

(70)
7/14 x 2/8 =

(70)
1/8

7/14 x 2/8 =

$$\frac{7 \times 2}{14 \times 8} = \frac{14}{112} = \frac{1}{8}$$

(71)
9/12 x 1/3 =

(71)
1/4

9/12 x 1/3 =

$$\frac{9 \times 1}{12 \times 3} = \frac{9}{36} = \frac{1}{4}$$

DIAGNOSTIC FRAME

(72)

Very good. Now for DIVISION OF FRACTIONS.

Divide 1 3/8 by 1 1/4.

(72)

1 1/10

1 3/8 + 1 1/4 =

11/8 + 5/4 =

11/8 x 4/5 =

$$\frac{11 \times 4}{8 \times 5} = \frac{44}{40} = 1\frac{4}{40} = 1\frac{1}{10}$$

IF YOU ANSWERED THE PROBLEM CORRECTLY, SKIP TO FRAME NUMBER 83; OTHERWISE, BEGIN WITH THE NEXT FRAME.

	(73) When we have a problem in division, such as 1/3 ÷ 1/9 a, we first must invert the divisor. (A common error here is to go ahead and multiply before inverting the divisor.) The next step is to multiply just as we did in the multiplication of fractions. 1/3 ÷ 1/9 = 1/3 x 9/1 = $\frac{1 \times 9}{3 \times 1} = \frac{9}{3} = 3$
	(74) 9/3 is an example of an _____ fraction.
(74) improper	(75) To practice: 5/16 ÷ 3/5 = (Don't forget to invert the divisor!)

(75)

25/48

5/16 ÷ 3/5 =

5/16 x 5/3 =

$$\frac{5 \times 5}{16 \times 3} = \frac{25}{48}$$

(76)

25/48 _____ be reduced.
(can/cannot)

(76)

cannot

(77)

5/8 ÷ 5/16 =

2/3 ÷ 3/8 =

(77)

2, 1 7/9

5/8 ÷ 5/16 =

5/8 x 16/5 =

$$\frac{5 \times 16}{8 \times 5} = \frac{80}{40} = 2$$

2 1/3 ÷ 1 1/2 =

2/3 x 8/3 =

$$\frac{2 \times 8}{3 \times 3} = \frac{16}{9} = 1\ 7/9$$

(78)

2 1/3 ÷ 1 1/2 = ****

To obtain a fraction from a mixed number, you must multiply the whole number times the denominator and then add the numerator to the product and put this sum over the original denominator as the new numerator.

2 1/3 ÷ 1 1/2 =

(2 x 3 = 6, 6 + 1 = 7)

(1 x 2 = 2, 2 + 1 = 3)

7/3 ÷ 3/2 =

7/3 x 2/3 = 14/9 = 1 5/9

	(79) 6/15 + 5 1/8 =
(79) 16/205 6/15 ÷ 5 1/8 = 6/15 ÷ 41/8 = 6/15 x 8/41 = $\frac{6 \times 8}{15 \times 41} = \frac{48}{615} = \frac{16}{205}$	(80) 5 6/7 ÷ 2 2/5 =
(80) 2 37/84 5 6/7 ÷ 2 2/5 = 41/7 ÷ 12/5 = 41/7 x 5/12 = $\frac{41 \times 5}{7 \times 12} = \frac{205}{84} = 2\frac{37}{84}$ IF YOU ANSWERED THE LAST TWO (2) FRAMES CORRECTLY AND DO NOT FEEL THE NEED FOR ADDITIONAL PRACTICE, SKIP THE NEXT TWO (2) FRAMES; OTHERWISE, DO THESE TWO (2) FRAMES.	(81) 2 1/4 ÷ 3/7 =
(81) 5 1/4 2 1/4 ÷ 3/7 = 9/4 ÷ 3/7 = 9/4 x 7/3 = $\frac{9 \times 7}{4 \times 3} = \frac{63}{12} = 5\frac{1}{4}$	(82) 5 1/8 ÷ 6 2/7 =

(82)

287/352

5 1/8 ÷ 6 2/7 =

41/8 ÷ 44/7 =

41/8 x 7/44 =

$$\frac{41 \times 7}{8 \times 44} = \frac{287}{352}$$

(83)

When you are asked to round off a number, you must determine whether the additional digit (which is to be dropped) is 5 or more.* If this additional digit is 5 or more, you must add 1 to the last digit that will remain in the answer; if this additional digit is 4 or less, the last digit remains unchanged.

For example:

a. .7787 (round off to three (3) decimal places)

Answer: .779. Since 7 is more than 4, 1 is added to 8 to make 9.

b. .7897 (round off to three (3) decimal places)

Answer: .790. Since 7 is more than 4, 1 is added to 9 to make 10 and the 1 is carried over to the next digit, 8, to make 9.

c. .7443 (round off to three (3) decimal places)

Answer: .744. Since the 3 is less than 5, the last digit, 4, will remain unchanged.

*"Rounding-Off" of decimals - remember, even though you must work out problems to the highest number of places any element in the problem contains, your answer may be accurate only to the degree of accuracy of your meter. If your meter will measure only to one tenth or one hundredth then your answer with five or six figures to the right of the decimal would not be measurable, and the answer should be rounded off.

(84)

Now let's practice.

a. .84364 (round off to four (4) decimal places). Answer: _____

b. .32245 (round off to four (4) decimal places). Answer: _____

(84)

a. .8436

b. .3225

(85)

You must be able TO CONVERT COMMON FRACTIONS TO DECIMAL FRACTIONS. To convert, divide the numerator by denominator to receive the decimal results. For example:

$$1/3 = \quad .333 \;\overline{)\,1.000}$$

$$\begin{array}{r} 9 \\ \hline 10 \\ 9 \\ \hline 10 \\ 9 \\ \hline 1 \end{array}$$

Place a decimal point after the units digit of the numerator and add one zero to secure the decimal quotient expressed in tenths (2 zeros for the decimal quotient in hundredths and 3 zeros for the decimal quotient in thousandths).

	(86) 7/8 = _____ (Convert to a decimal fraction)
(86) .875 .875 8/ 7.000 6 4 60 56 40 40	(87) 3/4 = _____ (decimal fraction)
(87) .75 .75 4/ 3.00 2 8 20 20	(88) 5/8 = _____ (decimal fraction)

(88)

.625

```
   .625
8/ 5.000
  4 8
  --
   20
   16
   --
    40
    40
```

(89)

72/80 = ****

A short cut to converting a fraction to a decimal when possible, is to reduce the fraction and then divide to find the decimal value.

72/80 = 9/10

```
   .9
10/ 9.0
   9 0
```

(90)

4/26 = _____

(Round off to three decimal places)

(90)

.154

4/26 = 2/13

```
   .1538 ⟶ .154
13/ 2.0000
  1 3
  --
   70
   65
   --
    50
    39
    --
    110
    104
    ---
      6
```

(91)

9/270 = _____

(Round off to two decimal places)

(91)

.03

9/270 = 1/30

$$
\begin{array}{r}
.033 \longrightarrow .03 \\
30\overline{)\,1.000} \\
\underline{\;\;90} \\
\;\;100 \\
\underline{\;\;90} \\
\;\;10
\end{array}
$$

(92)

Fine, now let's try ADDITION OF DECIMALS.

When the numbers containing the decimals are lined up, the problem should look like this -

6.89
+.357

The next problem is to see if the top quantity has the same number of digits to the right of the decimal point as the second or bottom quantity has. If there is a difference, a zero is added or placed for each digit needed.

Remember placing zeros after a decimal point (to the right) does not change the value. In this problem a zero is added or placed after the "9" to make the addition easier by lining up vertical columns.

6.890
+.357

(93)

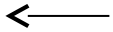
Now let's add.

2.063 + .0026 = (Hint: Convert to vertical form before adding.)

(93)

2.0656

2.063 + .0026 =



2.0630 Add zero
+ .0026
2.0656

(94)

0.135 + 0.435 + 2.31 + 0.0012 + 0.9 =

(94)

3.7812

0.1350
0.4350
2.3100
0.0012
0.9000
3.7812

(95)

1.416 + 0.1 + 0.0001 + 3.2865 + 1.4 =

(95)

6.2026

1.4160
0.1000
0.0001
3.2865
1.4000
6.2026

(96)

Now let's subtract.

14.7500
- .0036

(96)
14.7464

14.7500
<u>- .0036</u>
14.7464

(97)
Zeros can be eliminated from the answer when they are to the <u>right</u> of the decimal point and are not followed by any other digit. Thus, 54.7500, in final form, would read 54.75. Remember zeros to the right of the decimal when not followed by any other digits do not change the _____ of the quantity.

(97)
value

(98)
Thus 50.0020, in final form, would read _____.

4.0200, in final form, would read _____.

(98)
<u>50.002, 4.02</u>

(99)
41.75 - 2.63 =

(99)
Note borrowing of 10 from 4.

$$\begin{array}{r} 41.75 \\ -2.63 \\ \hline 39.12 \end{array}$$

DIAGNOSTIC FRAME

(100)

Now let's multiply

3.003 x 4.05=

(100)

12.16215

$$\begin{array}{r} 3.003 \\ \times\ 4.05 \\ \hline 150\ 15 \\ 12012\ 00 \\ \hline 12.162\ 15 \end{array}$$

IF YOU ANSWERED THE PROBLEM CORRECTLY AND DO NOT THINK THAT YOU NEED ANY ADDITIONAL PRACTICE, SKIP TO FRAME NUMBER 104; OTHERWISE, START WITH THE NEXT FRAME.

	(101) 3.14 x 3.285 Remember when multiplying numbers containing decimals, count the number of digits to the right of the decimal point in each of the multipliers, add these, and place the decimal point in the product so that an equal number of digits are to its right. For example, in this problem, the first multiplier has two digits to the right of the decimal, the second multiplier has three, and the product must then have five.
(101) 10.3149 3.285 x3.14 13140 32850 985500 10.31490 Rounding off → 10.3149	(102) 1.123 x 0.013 =

(102)

.014599

$$\begin{array}{r} 1.123 \\ \times 0.013 \\ \hline 3369 \\ 11230 \\ \hline .014599 \end{array}$$

(103)

23.08 x 11 =

(103)

253.88

$$\begin{array}{r} 23.08 \\ \times 11 \\ \hline 2308 \\ 23080 \\ \hline 253.88 \end{array}$$

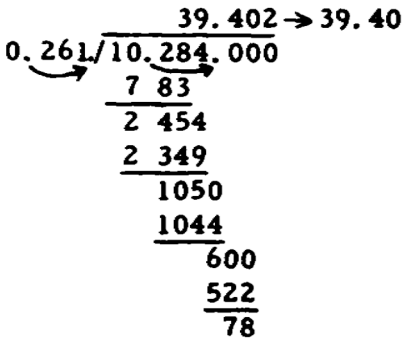
DIAGNOSTIC FRAME

(104)
Good job. Now let's divide.

Divide 10.284 by 0.261
(round off to <u>two (2)</u> places beyond the decimal point).

(104)

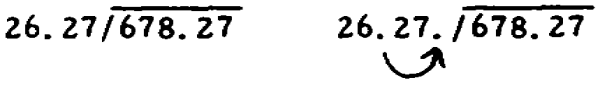
39.40



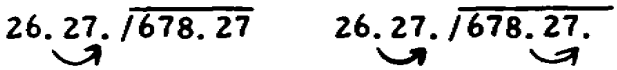
IF YOU ANSWERED THE PROBLEM CORRECTLY, AND FEEL YOU DO NOT NEED ADDITIONAL PRACTICE, SKIP TO NUMBER 116; IF YOU ONLY MISSED THE PROBLEM BECAUSE OF INCORRECT ROUNDING OFF, SKIP TO FRAME NUMBER 108; OTHERWISE, BEGIN BY DOING THE NEXT FRAME.

(105)

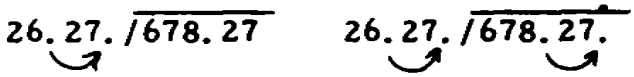
When your divisor contains decimals, count the number of places in the divisor to the right of the decimal point and move the decimal to the right that number of places to make the divisor a whole number.



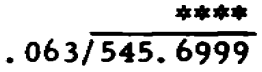
If the dividend already contains a decimal, move the decimal to the right the same number of places as moved in the divisor (adding zeros if necessary).



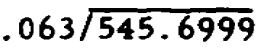
Then, place a decimal point in the quotient immediately above the new decimal place in the dividend.



(106)



Before dividing, you must make the divisor a whole number by moving the decimal point as far to the right as is needed; also, you must move the decimal point in the dividend the same number of digits to the right as was done in the divisor. Following the above instructions, the above problem would be as follows:



(move decimals)

(106)

.063. /545.699.9

(107)

.063. /545.699.9

Now divide the above problem. Don't worry if a remainder may appear.

(107)

```
      8 661.9
.063. /545.699.9
    504
     416
     378
      389
      378
       119
        63
        569
        567
          2 remainder
```

(108)

To practice:

25.75 ÷.05 =

(108)

```
      515.
.05./25.75
   25
    7
    5
   25
   25
```

(109)

327.66 ÷ .00023 =

(Disregard the remainder.)

(109)

```
          1424608.
      ---------------
.00023. /327.66000.
        23
        ---
         97
         92
         --
          56
          46
          --
          106
           92
           --
           140
           138
           ---
            200
            184
            ---
             16 remainder
```

(110)

1.1732 ÷ 1.31 = (Carry the quotient or answer out to six (6) places and then round off to five places.)

(110)

.895572 → .89557
1.31. / 1.17.320000
1048
1252
1179
730
655
750
655
950
917
330
262
68 remainder

(111)

0.0248 ÷ 0.0113 =
(Carry out to four (4) places beyond the decimal point and then round off to three places.)

(111)

2.1946 → 2.195
0.0113. / 0.0248.0000
226
220
113
1070
1017
530
452
780
678
102 remainder

(112)

If you have a dividend which does not contain a decimal, place a decimal point after the whole number, and then move the decimal the number of places that you moved the decimal point in the divisor. For example:

26.27/6782

26.27. / 6782.00.

	(113) 485 ÷ 1.638 = (Carry out to two (2) places beyond the decimal point and then round off to one place.)
(113) 296.09 → 296.1 1.638. / 485.000.00 327 6 15740 14742 9980 9828 15200 14742 458 remainder	(114) 546 ÷ 0.91 =
(114) 600. 0.91. / 546.00. 546	(115) 4.96 ÷ 62 =
(115) .08 62/4.96 4 96 When the divisor is <u>not</u> a decimal, you do not have to move the decimal point before dividing.	

	(116) Well done. Let's try the METRIC PREFIXES. Before proceeding further, please pull out your METRIC DATA CONVERSION SHEET at the rear of this text. You will need it to work problems dealing with the METRIC PREFIXES. At the top of the sheet, you will find several columns (entitled PREFIXES, SYMBOLS, VALUES, and ASSOCIATED WITH). To determine the symbol for a prefix (having found the prefix), you must look straight across to the SYMBOLS column and you will find the symbol. The symbol for the prefix mega is M.
	(117) The symbol for the prefix kilo is _____.
(117) K	(118) The symbol for micro-micro is _____.
(118) uu IF YOU FEEL YOU DO NOT NEED MORE PRACTICE SKIP THE NEXT TWO (2) FRAMES; OTHERWISE, DO THE NEXT TWO (2) FRAMES.	(119) Milli has the symbol of _____.

(119) m	(120) Micro has the symbol _____.
(120) u	(121) A metric prefix can be replaced by a symbol. The symbol "M" is used for _____.
(121) mega	(122) "K" is used for _____.
(122) kilo	(123) "u" is used for _____.
(123) micro	(124) To determine the value of a prefix, use the PREFIXES column and the VALUES column. Remember to look straight across the sheet. Micro-micro or pico has a value of one trillionth.

	(125) The value of the metric prefix mega is _____.
(125) one million	(126) Kilo has a value of a _____.
(126) thousand IF YOU FEEL YOU DO NOT NEED MORE PRACTICE, SKIP THE NEXT TWO (2) FRAMES; OTHERWISE, DO THE NEXT TWO (2) FRAMES.	(127) One thousandth is the value of the prefix _____.
(127) milli	(128) Micro's value is _____ _____.

(128) one millionth	(129) You should be familiar with how the prefixes are commonly used. To determine this, use the PREFIXES column and the ASSOCIATED WITH column. Again remember to look straight across the sheet. DO NOT USE THE "CONVERSION FACTORS" TABLE FOR THESE PROBLEMS. Mega is associated with ohms and cycles.
	(130) Micro-micro is ASSOCIATED WITH _____.
(130) farads	(131) Volts is ASSOCIATED WITH three (3) metric prefixes: micro, kilo, and _____.
(131) milli	(132) Watts is ASSOCIATED WITH the metric prefixes, _____, _____ , and _____.

(132) kilo, milli, micro.	(133) Amps is ASSOCIATED WITH the metric prefixes _____ and _____.
(133) milli, micro	(134) Henries is ASSOCIATED WITH the metric prefixes _____ and _____.
(134) milli, micro	(135) Mega is ASSOCIATED WITH o_____ and c_____
(135) ohms, cycles	(136) Milli is ASSOCIATED WITH v____, a____, w____, and h____.

(136) volts, amps, watts, henries	(137) Micro is ASSOCIATED WITH v____, a____, h____, and f____.
(137) volts, amps, henries, farads	(138) Kilo is ASSOCIATED WITH v____, o____, c____, and w____.
(138) volts, ohms, cycles, watts	(139) Farads alone is ASSOCIATED WITH the prefix _____ or _____.
(139) micro-micro, or pico	(140) One should memorize the metric prefixes, because the METRIC DATA CONVERSION SHEET may not always be available. The metric prefixes should be _____.
(140) memorized	(141) The METRIC DATA CONVERSION SHEET may not always be available. One should _____ the metric prefixes.

(141)
memorize

(142)
Good. Let's convert factors. Under the heading CONVERSION FACTORS, there are four columns - GIVEN, TO OBTAIN, MULT. BY, and DIVIDE BY. In your problems you will be given a factor (first column), then you will be told to obtain another factor (use column #2) and lastly, you will determine whether to multiply or divide and by what figure (third or fourth columns). Remember to look straight across the sheet.

For instance, given 2 amperes and told to obtain milliamperes, you would multiply 2 times 1,000 to arrive at an answer of 2,000 milliamperes.

(143)
If you have 2,000,000 cycles and you convert it to megacycles, you will have _____ megacycles.

(143)
2

2,000,000 ÷ 1,000,000 = 2

(144)
When you have to change volts to millivolts, you have to multiply by _____.

(144)
1,000

(145)
If you change .0000003 farads to microfarads, you have _____ microfarads.

(146)
.3

1,000,000 x .0000003 = .3000000 = .3

(146)

1,000,000 x .0000003 = .3

In this case, we do not have to multiply by the long process; instead, we count the number of digits to the right of the decimal point; then, having obtained a total, we count the same number of digits starting at the left of the decimal point ⟶ .1,000,000. and place our decimal point; lastly, we multiply by 3 to obtain our answer of .3.

(147)
1 farad equals _____ microfarads.

(147)
1,000,000

1,000,000 x 1 = 1,000,000

(148)
63 milliamperes will give us _____ amperes.

(148)

.063

63 ÷ 1,000 = .063
Actually we did not multiply by the long process. We count the number of zeros in 1,000 (which is 3) and we move the decimal point three (3) places to obtain our answer.

.063

IF YOU FEEL YOU DO NOT NEED ADDITIONAL PRACTICE, SKIP TO FRAME NUMBER 153; OTHERWISE, DO THE NEXT FOUR (4) FRAMES.

(149)

To convert kilovolts to volts we must _____ by 1,000.

(149)

multiply

(150)

If you have 9,720,000 cycles per seconds and you convert it to megacycles, you have _____ megacycles.

(150)
9.72

9,720,000 ÷ 1,000,000

9,720,000 ÷ 1,000,000 = 9.72

(151)
.05 microfarads equals _____ micro-micro farads.

(151)
50,000

.05 x 1,000,000 =

.05. x 1000000. =

5 x 10,000 = 50,000

(152)
.004 amperes will give us _____ milliamperes.

(152)
4

.004 x 1,000 =

.004. x 1,000. =

4 x 1 = 4

DIAGNOSTIC FRAME

(153)

Very good. Now let's try SQUARE ROOT.

If you do not know how to calculate square root, please turn to frame Number 164 before attempting to work a problem. When you finish frame number 164, begin with frame number 154.

Problem:

Find the square root of 130. (Carry the root to <u>three (3)</u> places beyond the decimal point and round off to two places.)

(153)

<u>11.40</u>

$$
\begin{array}{r}
11.401 \\
\sqrt{1\,30.\,00\,00\,00} \\
1 \\
21\overline{)\,30} \\
21 \\
224\overline{)\,9\;\;00} \\
8\;\;96 \\
22801\overline{)\,\;\;4\;\;00\;\;00} \\
2\;\;28\;\;01 \\
\hline
1\;\;71\;\;99
\end{array}
$$

IF YOU ANSWERED THE PROBLEM CORRECTLY AND FEEL YOU DO NOT NEED ADDITIONAL PRACTICE, YOU MAY NOW TAKE THE QUIZ (PAGE 81); OTHERWISE, BEGIN WITH THE NEXT FRAME.

	(154) Do as directed. $\sqrt{225}$ Separate the radicand into the necessary groups.
(154) $\sqrt{2\,25}$	(155) $\sqrt{2\,25}$ Determine the number which when multiplied by itself (squared) will give you a product equal to the first digit group under the radical sign. If you cannot find a number which when multiplied by itself (squared) equals digit group under the radical sign, select the number which when squared is closest to (and smaller than) the digit group.
(155) $\begin{array}{r} 1 \\ \sqrt{2\,25} \end{array}$ $(1 \times 1 = 1)$	(156) $\begin{array}{r} 1 \\ \sqrt{2\,25} \end{array}$ Place the product of the number multiplied by itself below the group, subtract any difference, and bring this difference down. Then bring the next group down.
(156) $\begin{array}{r} 1 \\ \sqrt{2\,25} \\ 1 \\ \hline 1\,25 \end{array}$	(157) $\begin{array}{r} 1 \\ \sqrt{2\,25} \\ 1 \\ \hline 1\,25 \end{array}$ Double the trial square root (above the radical sign) and place it to the left of the difference obtained, allowing room for another digit.

(157)

$$\begin{array}{r} 1 \\ \sqrt{\underset{\frown}{2}\ \underset{\frown}{25}} \\ \underline{1} \\ 2/1\ 25 \end{array}$$

(158)

$$\begin{array}{r} 1 \\ \sqrt{\underset{\frown}{2}\ \underset{\frown}{25}} \\ \underline{1} \\ 2/1\ 25 \end{array}$$

Find the next digit of this divisor, which is the next digit of the root. Use a number which will enable the divisor when multiplied by the selected number to approximate the radicand; place this digit to the right of the divisor and the same digit below itself. Place it in the root above the appropriate group of the radicand.

(158)

$$\begin{array}{r} 1\ 5 \\ \sqrt{\underset{\frown}{2}\ \underset{\frown}{25}} \\ \underline{1} \\ 25/1\ 25 \\ \underline{5} \end{array}$$

(159)

$$\begin{array}{r} 1\ 5 \\ \sqrt{\underset{\frown}{2}\ \underset{\frown}{25}} \\ \underline{1} \\ 25/1\ 25 \\ \underline{5} \end{array}$$

Multiply the divisor by the new portion of the root, and place this product under the appropriate radicand.

(159)

$$\begin{array}{r} 1\ 5 \\ \sqrt{\underset{\frown}{2}\ \underset{\frown}{25}} \\ \underline{1} \\ 25/1\ 25 \\ \underline{5\ 1\ 25} \end{array}$$

There is no remainder.

(160)

Good. Now to practice:

$$\sqrt{144}$$

(160)

$$\begin{array}{r} 1\ \ 2 \\ \sqrt{1\ 44} \\ 1 \\ \hline 22 \mid\ 44 \\ 2\ \ 44 \\ \hline \end{array}$$

(161)

When we find the square root of 225, which is 15, we can make sure that the answer is correct by multiplying 15 x 15. In this case, we did the problem correctly because 15 x 15 = 225.

12 is a number which, when multiplied by itself, gives us the original number _____.

(161)

144

(162)

To practice:

$\sqrt{676}$

(162)

$$\begin{array}{r} 2\ \ 6 \\ \sqrt{6\ 76} \\ 4 \\ \hline 46 \mid 2\ 76 \\ 6\ \ 2\ 76 \\ \hline \end{array}$$

(163)

$\sqrt{5476}$

(163)

$$\begin{array}{r} 7\ \ 4 \\ \sqrt{54\ \ 76} \\ 49 \\ 144\ \big|\ 5\ \ 76 \\ \underline{\ 4\ \ \ } \\ \ \ 5\ \ 76 \\ \ \ \underline{\ \ \ \ \ } \end{array}$$

IF YOU FEEL YOU HAVE MASTERED THE SQUARE ROOT PROBLEMS SO FAR, DO FRAMES 165-167; IF YOU FEEL YOU HAVE NOT MASTERED SQUARE ROOT, DO THE REMAINING FRAMES.

(164)

To calculate square root, you must do the following:

(1a) Starting at the right (units column) of the quantity, separate the radicand (portion under the square root sign) into groups of two (2) digits.

$\sqrt{4306} \longrightarrow \sqrt{43\ 06}$

(1b) (If the quantity contains a decimal) From the right of the decimal point, separate this portion of the radicand into groups of two (2) digits each.

$\sqrt{26.04} \longrightarrow \sqrt{26.04}$

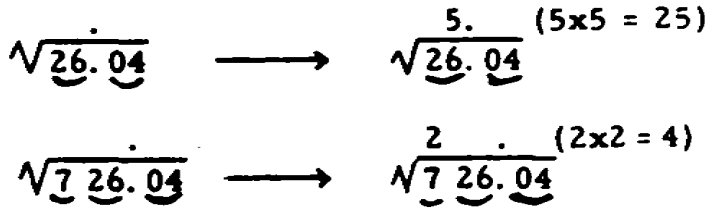
(1c) If the radicand does not contain an even number of digits to divide into groups, the remaining single number is treated the same as a group.

$\sqrt{726.04} \longrightarrow \sqrt{7\ 26.04}$

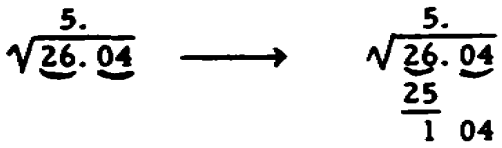
(2) Place a decimal point directly above the decimal point in the radicand

$\sqrt{26.04} \longrightarrow \sqrt{26.04}$

(3) Determine what number when multiplied by itself will approximate or equal the first group (or single digit) under the radical sign, and then place that number directly above the second digit of that group. For Example:

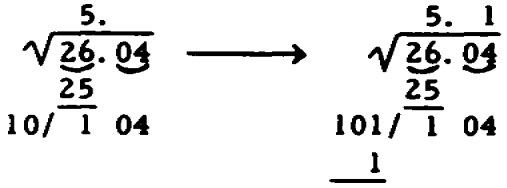


(4) Place the product of the number multiplied by itself below the group, subtract any difference, and bring this difference down.

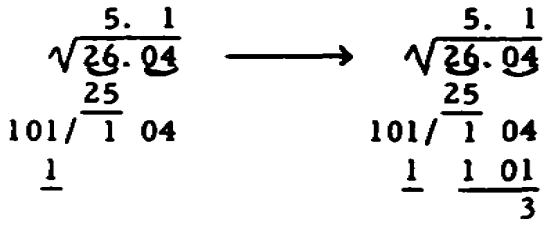


(5) Double the trial square root (above the radical sign) and place it to the left of the difference obtained, allowing room for another digit. This is your divisor.

(6) Find the next digit of this divisor, which is the next digit of the root. Use a number which will enable the divisor and the root when multiplied to approximate the new radicand; place this digit to the right of the divisor and the same digit below itself. Place it in the root above the digit of the appropriate group of the radicand.



(7) Multiply the divisor by the new portion of the root, and place this product under the appropriate radicand, subtract any remainder, and bring down the next group (if there is one) and repeat the operations in frames 5, 6, and 7. If the remainder (with an additional group of two zeros) is too small to permit the new divisor to be divided into it, carry the original remainder as a remainder.



The square root is 5.1 with a remainder of 3.

(165)

To practice:

$\sqrt{0.1024}$

(165)

$$\begin{array}{r} .32 \\ \sqrt{0.10\,24} \\ 9 \\ \hline 62/\ 1\,24 \\ 2\ \ 1\,24 \end{array}$$

(166)

$\sqrt{0.1936}$

(166)

$$\begin{array}{r} .44 \\ \sqrt{0.19\,36} \\ 16 \\ \hline 84/\ 3\,36 \\ 4\ \ 3\,36 \end{array}$$

(167)

$\sqrt{0.0729}$

(167)

$$\begin{array}{r} .\,2\;7 \\ \sqrt{0.07\;29} \\ \underline{4} \\ 47\,|\,3\;29 \\ \underline{7\;3\;29} \end{array}$$

IF THERE IS ANY BASIC MATH AREA STILL NOT CLEAR TO YOU, REVIEW THAT AREA; OTHERWISE, YOU MAY TAKE THE QUIZ (PAGE 80)

ADDITION TABLE

1 + 0 = 1	2 + 0 = 2	3 + 0 = 3	4 + 0 = 4	5 + 0 = 5
1 + 1 = 2	2 + 1 = 3	3 + 1 = 4	4 + 1 = 5	5 + 1 = 6
1 + 2 = 3	2 + 2 = 4	3 + 2 = 5	4 + 2 = 6	5 + 2 = 7
1 + 3 = 4	2 + 3 = 5	3 + 3 = 6	4 + 3 = 7	5 + 3 = 8
1 + 4 = 5	2 + 4 = 6	3 + 4 = 7	4 + 4 = 8	5 + 4 = 9
1 + 5 = 6	2 + 5 = 7	3 + 5 = 8	4 + 5 = 9	5 + 5 = 10
1 + 6 = 7	2 + 6 = 8	3 + 6 = 9	4 + 6 = 10	5 + 6 = 11
1 + 7 = 8	2 + 7 = 9	3 + 7 = 10	4 + 7 = 11	5 + 7 = 12
1 + 8 = 9	2 + 8 = 10	3 + 8 = 11	4 + 8 = 12	5 + 8 = 13
1 + 9 = 10	2 + 9 = 11	3 + 9 = 12	4 + 9 = 13	5 + 9 = 14

6 + 0 = 6	7 + 0 = 7	8 + 0 = 8	9 + 0 = 9
6 + 1 = 7	7 + 1 = 8	8 + 1 = 9	9 + 1 = 10
6 + 2 = 8	7 + 2 = 9	8 + 2 = 10	9 + 2 = 11
6 + 3 = 9	7 + 3 = 10	8 + 3 = 11	9 + 3 = 12
6 + 4 = 10	7 + 4 = 11	8 + 4 = 12	9 + 4 = 13
6 + 5 = 11	7 + 5 = 12	8 + 5 = 13	9 + 5 = 14
6 + 6 = 12	7 + 6 = 13	8 + 6 = 14	9 + 6 = 15
6 + 7 = 13	7 + 7 = 14	8 + 7 = 15	9 + 7 = 16
6 + 8 = 14	7 + 8 = 15	8 + 8 = 16	9 + 8 = 17
6 + 9 = 15	7 + 9 = 16	8 + 9 = 17	9 + 9 = 18

SUBTRACTION TABLE

1 - 0 = 1	2 - 0 = 2	3 - 0 = 3	4 - 0 = 4	5 - 0 = 5
1 - 1 = 0	2 - 1 = 1	3 - 1 = 2	4 - 1 = 3	5 - 1 = 4
	2 - 2 = 0	3 - 2 = 1	4 - 2 = 2	5 - 2 = 3
		3 - 3 = 0	4 - 3 = 1	5 - 3 = 2
			4 - 4 = 0	5 - 4 = 1
				5 - 5 = 0

6 - 0 = 6	7 - 0 = 7	8 - 0 = 8	9 - 0 = 9
6 - 1 = 5	7 - 1 = 6	8 - 1 = 7	9 - 1 = 8
6 - 2 = 4	7 - 2 = 5	8 - 2 = 6	9 - 2 = 7
6 - 3 = 3	7 - 3 = 4	8 - 3 = 5	9 - 3 = 6
6 - 4 = 2	7 - 4 = 3	8 - 4 = 4	9 - 4 = 5
6 - 5 = 1	7 - 5 = 2	8 - 5 = 3	9 - 5 = 4
6 - 6 = 0	7 - 6 = 1	8 - 6 = 2	9 - 6 = 3
	7 - 7 = 0	8 - 7 = 1	9 - 7 = 2
		8 - 8 = 0	9 - 8 = 1
			9 - 9 = 0

MULTIPLICATION TABLE

1 x 0 = 0	2 x 0 = 0	3 x 0 = 0	4 x 0 = 0	5 x 0 = 0
1 x 1 = 1	2 x 1 = 2	3 x 1 = 3	4 x 1 = 4	5 x 1 = 5
1 x 2 = 2	2 x 2 = 4	3 x 2 = 6	4 x 2 = 8	5 x 2 = 10
1 x 3 = 3	2 x 3 = 6	3 x 3 = 9	4 x 3 = 12	5 x 3 = 15
1 x 4 = 4	2 x 4 = 8	3 x 4 = 12	4 x 4 = 16	5 x 4 = 20
1 x 5 = 5	2 x 5 = 10	3 x 5 = 15	4 x 5 = 20	5 x 5 = 25
1 x 6 = 6	2 x 6 = 12	3 x 6 = 18	4 x 6 = 24	5 x 6 = 30
1 x 7 = 7	2 x 7 = 14	3 x 7 = 21	4 x 7 = 28	5 x 7 = 35
1 x 8 = 8	2 x 8 = 16	3 x 8 = 24	4 x 8 = 32	5 x 8 = 40
1 x 9 = 9	2 x 9 = 18	3 x 9 = 27	4 x 9 = 36	5 x 9 = 45

6 x 0 = 0	7 x 0 = 0	8 x 0 = 0	9 x 0 = 0
6 x 1 = 6	7 x 1 = 7	8 x 1 = 8	9 x 1 = 9
6 x 2 = 12	7 x 2 = 14	8 x 2 = 16	9 x 2 = 18
6 x 3 = 18	7 x 3 = 21	8 x 3 = 24	9 x 3 = 27
6 x 4 = 24	7 x 4 = 28	8 x 4 = 32	9 x 4 = 36
6 x 5 = 30	7 x 5 = 35	8 x 5 = 40	9 x 5 = 45
6 x 6 = 36	7 x 6 = 42	8 x 6 = 48	9 x 6 = 54
6 x 7 = 42	7 x 7 = 49	8 x 7 = 56	9 x 7 = 63
6 x 8 = 48	7 x 8 = 56	8 x 8 = 64	9 x 8 = 72
6 x 9 = 54	7 x 9 = 63	8 x 9 = 72	9 x 9 = 81

DIVISION TABLE

1 ÷ 0 = 0	2 ÷ 0 = 0	3 ÷ 0 = 0	4 ÷ 0 = 0	5 ÷ 0 = 0
1 ÷ 1 = 1	2 ÷ 1 = 2	3 ÷ 1 = 3	4 ÷ 1 = 4	5 ÷ 1 = 5
1 ÷ 2 = 1/2	2 ÷ 2 = 1	3 ÷ 2 = 1 1/2	4 ÷ 2 = 2	5 ÷ 2 = 2 1/2
1 ÷ 3 = 1/3	2 ÷ 3 = 2/3	3 ÷ 3 = 1	4 ÷ 3 = 1 1/3	5 ÷ 3 = 1 2/3
1 ÷ 4 = 1/4	2 ÷ 4 = 1/2	3 ÷ 4 = 3/4	4 ÷ 4 = 1	5 ÷ 4 = 1 1/4
1 ÷ 5 = 1/5	2 ÷ 5 = 2/5	3 ÷ 5 = 3/5	4 ÷ 5 = 4/5	5 ÷ 5 = 1
1 ÷ 6 = 1/6	2 ÷ 6 = 1/3	3 ÷ 6 = 1/2	4 ÷ 6 = 2/3	5 ÷ 6 = 5/6
1 ÷ 7 = 1/7	2 ÷ 7 = 2/7	3 ÷ 7 = 3/7	4 ÷ 7 = 4/7	5 ÷ 7 = 5/7
1 ÷ 8 = 1/8	2 ÷ 8 = 1/4	3 ÷ 8 = 3/8	4 ÷ 8 = 1/2	5 ÷ 8 = 5/8
1 ÷ 9 = 1/9	2 ÷ 9 = 2/9	3 ÷ 9 = 1/3	4 ÷ 9 = 4/9	5 ÷ 9 = 5/9

6 ÷ 0 = 0	7 ÷ 0 = 0	8 ÷ 0 = 0	9 ÷ 0 = 0
6 ÷ 1 = 6	7 ÷ 1 = 7	8 ÷ 1 = 8	9 ÷ 1 = 9
6 ÷ 2 = 3	7 ÷ 2 = 3 1/2	8 ÷ 2 = 4	9 ÷ 2 = 4 1/2
6 ÷ 3 = 2	7 ÷ 3 = 2 1/3	8 ÷ 3 = 2 2/3	9 ÷ 3 = 3
6 ÷ 4 = 1 1/2	7 ÷ 4 = 1 3/4	8 ÷ 4 = 2	9 ÷ 4 = 2 1/4
6 ÷ 5 = 1 1/5	7 ÷ 5 = 1 2/5	8 ÷ 5 = 1 3/5	9 ÷ 5 = 1 4/5
6 ÷ 6 = 1	7 ÷ 6 = 1 1/6	8 ÷ 6 = 1 1/3	9 ÷ 6 = 1 1/2
6 ÷ 7 = 6/7	7 ÷ 7 = 1	8 ÷ 7 = 1 1/7	9 ÷ 7 = 1 2/7
6 ÷ 8 = 3/4	7 ÷ 8 = 7/8	8 ÷ 8 = 1	9 ÷ 8 = 1 1/8
6 ÷ 9 = 2/3	7 ÷ 9 = 7/9	8 ÷ 9 = 8/9	9 ÷ 9 = 1

TABLE OF SQUARES AND SQUARE ROOTS

Number	Square	Square Root	Number	Square	Square Root
1	1	1.000	17	289	4.123
2	4	1.414	18	324	4.242
3	9	1.732	19	361	4.356
4	16	2.000	20	400	4.472
5	25	2.236	21	441	4.582
6	36	2.449	22	484	4.690
7	49	2.645	23	529	4.795
8	64	2.828	24	576	4.898
9	81	3.000	25	625	5.000
10	100	3.162	30	900	5.477
11	121	3.316	40	1600	6.324
12	144	3.464	50	2500	7.071
13	169	3.605	60	3600	7.746
14	196	3.742	70	4900	8.366
15	225	3.873	80	6400	8.944
16	256	4.000	90	8100	9.486

METRIC DATA CONVERSION SHEET

3801-1

PREFIXES	SYMBOLS	VALUES	ASSOCIATED WITH
MEGA	(M)	= MILLION	OHMS, CYCLES
KILO	(K)	= THOUSAND	VOLTS, OHMS, CYCLES, WATTS
MILLI	(m)	= ONE THOUSANDTH	VOLTS, AMPS, WATTS, HENRIES
MICRO	(u)	= ONE MILLIONTH	VOLTS, AMPS, HENRIES, WATTS, FARADS
MICRO-MICRO or PICO	(uu or p)	= ONE TRILLIONTH	FARADS

CONVERSION FACTORS

GIVEN	TO OBTAIN	MULT. BY	DIVIDE BY
AMPERES	MILLIAMPERES	1,000	
AMPERES	MICROAMPERES	1,000,000	
MICROAMPERES	AMPERES		1,000,000
MICROAMPERES	MILLIAMPERES		1,000
MILLIAMPERES	AMPERES		1,000
MILLIAMPERES	MICROAMPERES	1,000	
CYCLES PER SECOND	KILOCYCLES PER SECOND		1,000
CYCLES PER SECOND	MEGACYCLES PER SECOND		1,000,000
KILOCYCLES PER SECOND	CYCLES PER SECOND	1,000	
KILOCYCLES PER SECOND	MEGACYCLES PER SECOND		1,000
MEGACYCLES PER SECOND	CYCLES PER SECOND	1,000,000	
MEGACYCLES PER SECOND	KILOCYCLES PER SECOND	1,000	
FARADS	MICROFARADS	1,000,000	
FARADS	MICRO-MICRO FARADS	1,000,000,000,000	
MICROFARADS	FARADS		1,000,000
MICROFARADS	MICRO-MICRO FARADS	1,000,000	
MICRO-MICRO FARADS	FARADS		1,000,000,000,000
MICRO-MICRO FARADS	MICROFARADS		1,000,000
HENRIES	MILLIHENRIES	1,000	
HENRIES	MICROHENRIES	1,000,000	
MICROHENRIES	HENRIES		1,000,000
MICROHENRIES	MILLIHENRIES		1,000
MILLIHENRIES	HENRIES		1,000
MILLIHENRIES	MICROHENRIES	1,000	

GIVEN	TO OBTAIN	MULT. BY	DIVIDE BY
OHMS	KILOHMS		1,000
OHMS	MEGOHMS		1,000,000
KILOHMS	OHMS	1,000	
KILOHMS	MEGOHMS		1,000
MEGOHMS	OHMS	1,000,000	
MEGOHMS	KILOHMS	1,000	
VOLTS	KILOVOLTS		1,000
VOLTS	MILLIVOLTS	1,000	
VOLTS	MICROVOLTS	1,000,000	
KILOVOLTS	VOLTS	1,000	
MICROVOLTS	VOLTS		1,000,000
MICROVOLTS	MILLIVOLTS		1,000
MILLIVOLTS	VOLTS		1,000
MILLIVOLTS	MICROVOLTS	1,000	
WATTS	KILOWATTS		1,000
WATTS	MILLIWATTS	1,000	
WATTS	MICROWATTS	1,000,000	
KILOWATTS	WATTS	1,000	
MICROWATTS	WATTS		1,000,000
MICROWATTS	MILLIWATTS		1,000
MILLIWATTS	WATTS		1,000
MILLIWATTS	MICROWATTS	1,000	

SELF QUIZ

1.
Add 1/5, 1/7, 2/3, and
4/9.

2.
Subtract 1/3 from 5/7.

3.
Multiply 2/5 times 9/4.

4.
Divide 1 2/3 by 2/9.

5.

$$\begin{array}{r} 0.245 \\ 3.21 \\ 0.534 \\ 0.0031 \\ \underline{0.90} \end{array}$$

6.

$$\begin{array}{r} 0.44 \\ \underline{-0.0028} \end{array}$$

7.

1.004
x5.03

8.

Divide 0.0248 by 0.0113
(round off to two places
beyond the decimal
point).

0.0113 / 0.0248

---

9. What is the value of kilo? _____

10. What metric prefix does the symbol "m" stand for? _____

11. Convert 2 microhenries to henries.

12. Find the square root of 150 correct to the second decimal (round off).

$\sqrt{150}$

NOW CHECK YOUR ANSWERS TO THE QUIZ (PGS. 86, 87, AND 88) AND SEE HOW WELL YOU HAVE DONE. ONE MISTAKE IS CONSIDERED EXCELLENT. REVIEW ANY BASIC MATH AREA STILL NOT CLEAR TO YOU.

ANSWERS TO QUIZ

1. 1 143/315

$1/5 + 1/7 + 2/3 + 4/9 =$

$189 + 135 + 630 + 420 = \frac{1374}{945} = 1\frac{429}{945} =$

$(5 \times 7 \times 3 \times 9 = 945)$

$1\frac{429}{945} = 1\frac{143}{315}$

2. 8/21

$5/7 - 1/3 =$

$15/21 - 7/21 = 8/21$

3. 9/10

$2/5 \times 9/4 =$

$2/5 \times 9/4 = 18/20 - 9/10$

4. 7 1/2

$1\ 2/3 \div 2/9 =$

$5/3 \div 2/9 =$

$5/3 \times 9/2 =$

$5/3 \times 9/2 = 45/6 = 7\ 3/6 = 7\ 1/2$

5. 4.8921

$$\begin{array}{r} 0.2450 \\ 3.2100 \\ 0.5340 \\ 0.0031 \\ 0.9000 \\ \hline 4.8921 \end{array}$$

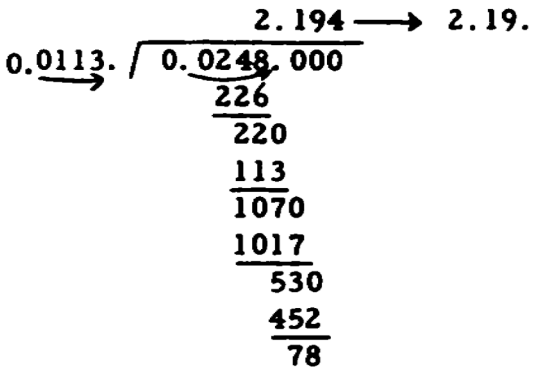
6. 0.4372

$$\begin{array}{r} 0.4400 \\ -\ 0.0028 \\ \hline 0.4372 \end{array}$$

7. 5.05012

$$\begin{array}{r} 1.004 \\ \times 5.03 \\ \hline 3012 \\ 502000 \\ \hline 5.05012 \end{array}$$

8. 2.19

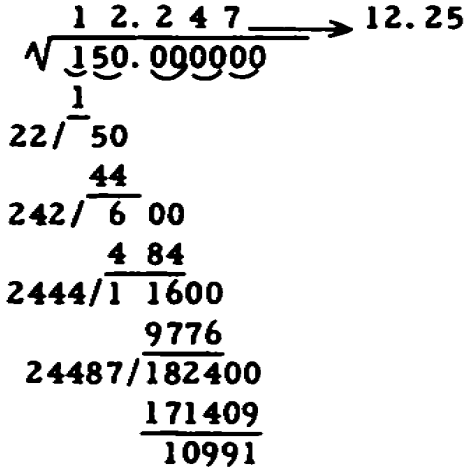


9. Thousand

10. Milli

11. .000002 henries 2 ÷ 1,000,000 = .000002 henries

12. 12.25



SECTION 2

TABLE OF CONTENTS

		Page	Frame
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2.	The symbols in a formula	15	8
3.	Substituting and solving	23	12
4.	The R_T formula	7	19
5.	Metric numbers	11	21
6.	Solving problems using metric numbers	21	40
7.	Converting base to metric	55	54
8.	The $\frac{1}{R_T}$ formula	51	65

OBJECTIVES

SECTION 2

As a result of taking this section of BASIC MATHEMATICS, you must be able to:

1. Solve problems using formulas.
2. Solve problems using metric numbers.

INTRODUCTION

Much of electronics is concerned with arithmetic. The technician must be able to figure out resistances, voltages, current, etc. Fortunately, formulas have been developed to help you find these values. Formulas depend on your knowing certain values, from which you find an unknown value. In electricity, these values are often reported as metric numbers (such as 3 μ, 5M) for the sake of convenience.

No attempt is made in this text to establish a relationship between the formulas and numbers and the concepts of basic electricity. You will learn the meanings and applications of all of these formulas in other subcourses. By that time, you are expected to already be able to use the formulas to solve problems.

The frames in this section are arranged differently than those in Section 1. However, by following the directions given, you will be able to easily proceed through the text.

1.

$$E = IR$$

This is a FORMULA. This text will teach you how to solve a _____.

Turn the page

DO NO READ DOWN THE PAGE.

29.

M stands for 1,000,000. 5M equals (number) _____. To get the answer, you _____ 5 times 1,000,00.

53.

Solve this problem without help.

$$I = \frac{E}{R} \; ; \; E = 4m, \; R = 2\mu$$

I = _____

1a.

formula

Turn the page →

29a.

5,000,000

multiplied

53a.

I = 2000

Solution:

$$I = \frac{E}{R}$$

$$I = \frac{4m}{2\mu}$$

$$I = \frac{.004}{.000002}$$

$$I = 2000$$

DIVISION:

$$.000002 \overline{)\ .004000}\ 2000.$$

2.

A formula is like a rule. It tells you how to solve an arithmetic problem. It tells you how to find the correct _____.

30.

Solve these multiplication problems.

.001	.001	.001
x 3	x 14	x 4.7
____	____	_____

Now, convert these metric numbers. m stands for .001 (one thousandth).

3m = _____

4.7m = _____

14m = _____

54.

Sometimes you must report the answer to a problem as a metric number. To do this, you must convert a base number to its _____ equivalent.

2a.

answer

30a.

.003

.014

.0047

3m = .003

4.7m = .0047

14m = .014

NOTE: If you missed any of these, go back and find out exactly what you did wrong. Do not make the same mistake again.

54a.

metric

3.

$$A = B + C$$

This formula tells you how to find A. You would use this formula if you wanted to find a value for _____.

31.

m stands for .001 (one thousandth).

Convert these metric numbers to base numbers.

1.4m = _____

2.86m = _____

.5m = _____

55.

Every number has a decimal point. (It doesn't always show.) You can convert a base number to a metric number by moving the _____.

3a.

A

31a.

.0014

.00286

.0005

NOTE: If you missed any of these, go back and find out exactly what you did wrong. Do not make the same mistake again.

55a.

decimal point

4.

$$E = I \times R$$

When you use this formula, you will find a value for _____.

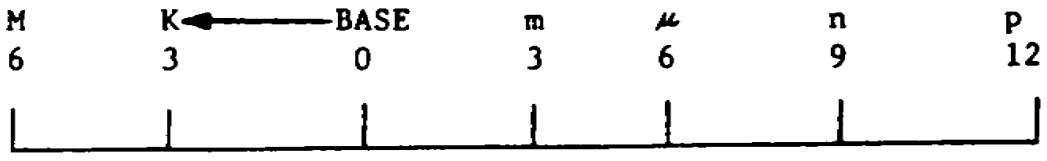
32.

Practice multiplying decimal fractions. The important part (and the hardest) is getting the decimal point in the correct place.

.4	3.9	.6	4.5
x 1000	x .001	x .000001	x 1,000,000
_____	_____	_____	_____

56.

You will move the decimal point either to the left or the right. On the scale below we have drawn an arrow from BASE to K. This shows that to change a base number to thousandths, you move the decimal point three places to the left. For example, 3,000 = 3.000K = 3K



Now, add an arrow from BASE to μ.

4a.

E

32a.

400

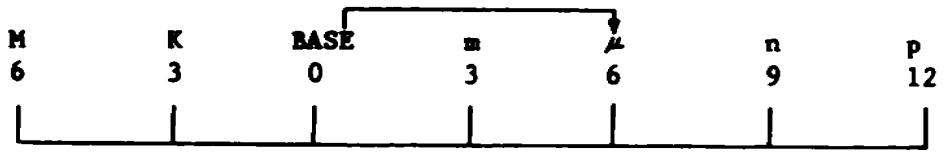
.0039

.0000006

4,500,000

NOTE: If you missed any of these, go back and find out exactly what you did wrong. Do not make the same mistake again.

56a.



5.

You can solve any arithmetic problem by either adding or _____ or multiplying or _____.

33.

Practice some more.

.5 x 1,000,000 = _____

1.7 x .001 = _____

3 x .000001 = _____

.006 x .001 = _____

57.

When converting from BASE to μ, you move the decimal six places to the right.

.006 = _____ μ

5a.

subtracting

dividing

33a.

500,000

.0017

.000003

.000006

NOTE: If you are still missing these problems, go back to step 30 and practice them all again. You cannot learn any more until you do this correctly -- so learn it now.

57a.

.006 = 6,000μ

6.

A formula tells you how to solve an arithmetic problem. It tells you whether to add or _____ or multiply or _____.

34.

μ (this is read as "micro") means .000001 (one millionth).

Convert these metric numbers to base numbers.

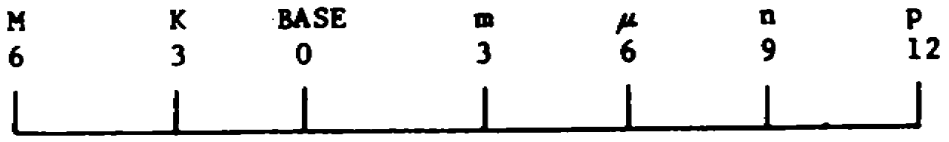
73μ = _____

$.5\mu$ = _____

8μ = _____

58.

Draw an arrow from BASE to M.



Which way will you move the decimal point to convert 6,000,000 to M? (Right/Left) _____

6a.

subtract

divide

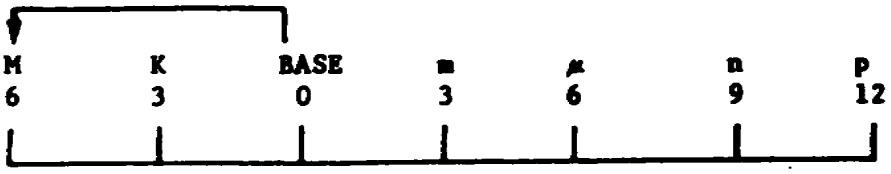
34a.

.000073

.0000005

.000008

58a.



Left

7.

A formula does not actually say "add," "subtract," etc. It uses symbols. For example, "+" is a symbol meaning to _____.

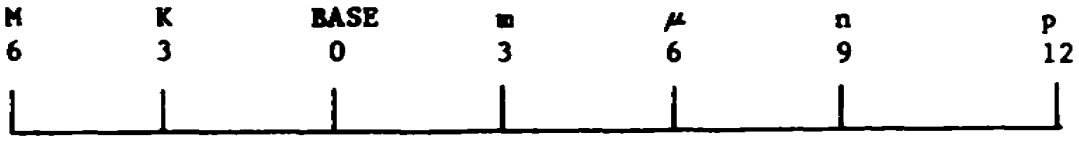
35.

n (this is read "nano") means 0.000000001 (one billionth). Convert this metric number to its base equivalent.

75n = _____

.2n = _____

59.



To convert from base to "m," we would move the decimal point (number) _____ places to the right.

7a.

add

35a.

0.000000075

0.0000000002

59a.

3

8.

Here are the symbols used in formulas.

+ means to _____.

- (used like this: X - Y) means to _____.

NO SYMBOL means to _____.

- (used like this: $\frac{X}{Y}$) means to _____.

36.

p (this is read "pico") means 0.000000000001 (one trillionth). Convert this metric number to its base equivalent.

45p = _____

60.

Which is the correct conversion of base to μ. Circle the letter of the correct answer.

	Base		Metric
a.	.143 =	143000 =	143,000μ
b.	.143 =	.143 =	143μ
c.	.143 =	000.143 =	.000143μ

8a.

add

subtract

multiply

divide

36a.

0.000000000045

(You should have 10 zeros in your answer.)

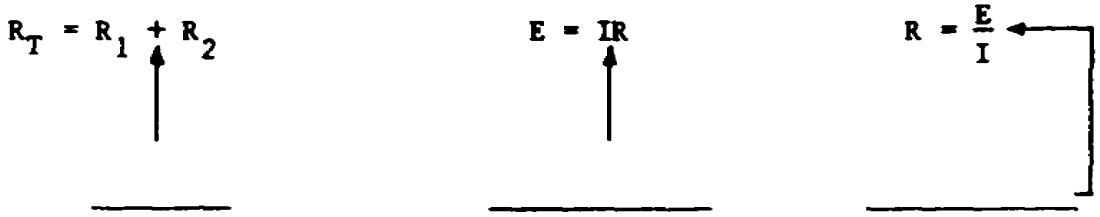
60a.

a. .143 = .143000 = 143,000 μ

(6 places to the right)

9.

What do these symbols mean?



_____ _____ _____

---

37. NOW, complete the following table:

Symbol	Means		Read
M	1,000,000	million	_____
K	_____	_____	kilo
_____	1/1,000 or 0.001	thousandths	_____
_____	_____	millionths	micro
_____	1/1,000,000,000 or _____		nano
p	1/1,000,000,000,000 or 0.000000000001		_____

61.

Convert these numbers to metric.

1. 16000.0 = 16000 = 16K
2. .189 = _____ = _____m
3. 40,000,000.0 = _____ = _____M
4. 300,000.0 = _____ = _____M

9a.

add

multiply

divide

37a.

METRIC SYSTEM TERMS

M	1,000,000	million	mega
K	1,000	thousand	kilo
m	1/1,000 or 0.001	thousandth	milli
μ	1/1,000,000 or 0.000001	millionth	micro
n	1/1,000,000,000 or 0.000000001		nano
p	1/1,000,000,000,000 or 0.000000000001		pico

61a.

2. .189 = .189 = 189m

3. 40,000,000.0 = 40.000000.0 = 40M

4. 300,000.0 = .300000.0 = .3M

10.

A = B + C

This formula tells you how to find _____. You get the answer by (adding/subtracting) _____ B and _____.

38.

You may use your METRIC NUMBER TABLE to help you answer these questions.

75μ = _____

16K = _____

3.5M = _____

.98m = _____

61b.

If you missed any of the problems on the last step, do the problems on this step. Otherwise, go on to the next step.

.14 = _____ = _____m

4,100,000 = _____ = _____M

10a.

A

adding

C

38a.

.000075

16,000

3,500,000

.00098

61c.

.14 = .140 = 140m

4,100,000 = 4.100000 = 4.1M

11.

E = IR

How would you find E? *_____

38b.

If you missed the last step, number 38, take this step. If you got the last step correct, skip this step.

3μ = _____

45K = _____

.17M = _____

1.4m = _____

62.

Now solve this problem. Report the answer in M.

E = IR; I = 3K, R = 6K

E = _____M

11a.

*By multiplying I times R

NOTE: This step has an asterisk (*). Your answer need not be in the exact words. The important thing is that your answer mean the same thing.

38c.

.000003

45,000

170,000

.0014

62a.

E = 18M

Solution:

E = IR

E = 3K x 6K

E = 3000 x 6000

E = 18,000,000

E - 18M

12.

$$E = IR$$

This formula tells you how to find E. It tells you to multiply I times R. But you cannot multiply letters. You can only multiply _____.

39.

Throughout your electricity and electronics course, you will be asked to solve formulas. The numbers you will use will often be in this form: 5K, 38m, etc. These are called _____ numbers.

63.

$$C = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4} + \cdots$$

This formula looks similar to $R_T = R_1 + R_2 + R_3 + R_4 + \cdot \cdot \cdot$. However, if you look closely you will see that it is _____ the same.

12a.

numbers

39a.

metric

63a.

not

13.

$$R_T = R_1 + R_2$$

Before you can add, you must replace the letters R_1 and R_2 with _____.

40.

$$E = IR;\ I = 5m,\ R = 2K$$

$$E = 5m \times 2K$$

In any problem using a formula, the first step is to replace the letters with numbers. Look at the example above. We replaced the letters (I and R) with _____ numbers (5m and 2K).

64.

$$C = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$

$\frac{1}{R_1}$ and $\frac{1}{R_2}$ are fractions. So far, you have only been required to add whole numbers. This formula requires you to add _____.

13a.

numbers

40a.

metric

64a.

fractions

14.

Here is a formula → $R_T = R_1 + R_2$

Here are the replacement numbers → $R_1 = 5, R_2 = 7$

Here we replaced the letters with numbers → $R_T = 5 + 7$

Here we solved the formula (by adding) → $R_T = 12$

NOW YOU DO IT:

Here is the formula → E - IR

Here are the replacement numbers → I = 2, R = 3

DO THIS → REPLACE THE LETTERS WITH NUMBERS E = _____ x _____

DO THIS → SOLVE THE FORMULA (by multiplying) E = _____

41.

If you try to add 3 apples and 4 oranges, you won't know what to call the answer. (orples?)

Can you add 3M and 4K? *_____

65.

$\frac{1}{4}$ ← NUMERATOR
DENOMINATOR

The bottom part of a fraction is called the _____.

14a.

E = 2 x 3

E = 6

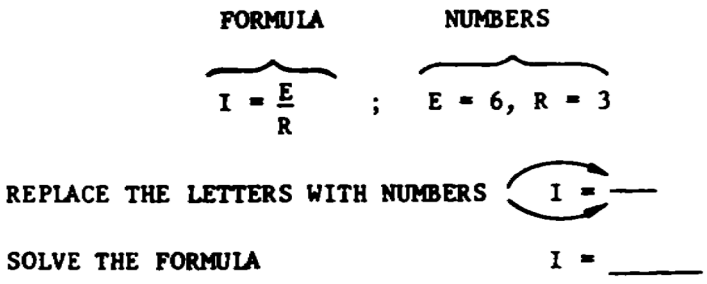
41a.

* Not in this form.

65a.

denominator

15.



42.

3M + 4K = ?

There are two ways to solve this problem.

A. Change both metric numbers to a common metric term, such as 3000K + 4K.

B. Change both metric numbers to their base equivalents, 3,000,000 + 4,000.

Since you already know how to do B, in this text we will use _____.

66.

Two fractions are equivalent if both can be reduced to the same fraction. For example, 1/3 = 15/45 because 15/45 can be reduced to 1/3 by dividing both numerator and denominator by 15.

Is it true that 4/10 = 12/30?

15a.

I = 6/3

I = 2

42a.

B

66a.

Yes, because 4/10 = 2/5 and 12/30 = 2/5.

16.

$$R_T = R_1 + R_2;\ R_1 = 3,\ R_2 = 4$$

REPLACE → _____

SOLVE → _____

43.

$$R_T = R_1 + R_2 + R_3 + R_4 + \cdots ;\ R_1 = .3K,\ R_2 = 78m$$

REPLACE: $R_T = .3K + 78m$

CONVERT: $R_T = 300 + .078$

SOLVE: $R_T = 300.078$

What are the three steps to solving a formula using metric numbers?

1. _____

2. _____

3. _____

67.

The sum of fractions having the same denominator is another fraction having the same denominator and a numerator that is equal to the sum of the given numerators. For example, $\frac{2}{7} + \frac{3}{7} = \frac{2+3}{7} = \frac{5}{7}$

$$\frac{2}{9} + \frac{5}{9} = ?$$

16a.

$R_T = 3 + 4$

$R_T = 7$

43a.

1. Replace (Also called substitute)
2. Convert
3. Solve

67a.

$\frac{7}{9}$

17.

Solve this problem.

$$E = IR;\ I = 2,\ R = 5$$

44.

Normally, to solve a formula you take two steps: substitute and solve. An extra step should be added when you are given metric numbers. The extra step is _____.

68.

When several fractions have the same denominator, we say they have a COMMON DENOMINATOR. The fractions 2/13, 5/13, and 7/13 have a _____ _____.

17a.

E =10

Solution:

E = 2 x 5

E = 10

44a.

convert

68a.

common denominator

18.

Solve this problem.

$$R = \frac{E}{I} \; ; \; E = 14, \; I = 7$$

45.

Do you know how to substitute? _____

Do you know how to convert? _____

Do you know how to solve? _____

69.

In adding fractions with different denominators it is customary first to replace the fractions with equivalent fractions having the same (a common) denominator. For example,

$$\frac{1}{2} + \frac{2}{5} = \frac{5}{10} + \frac{4}{10} = \frac{?}{10}$$

18a.

R = 2

Solution:

$$R = \frac{14}{7}$$

$$R = 2$$

45a.

yes

yes

yes

NOTE: As you know, you have just learned how to do each of these three things in this lesson.

69a.

9

19.

$$R_T = R_1 + R_2 + R_3 + R_4 + \cdots$$

The R_T formula is usually written this way. The three dots, ..., simply mean that you use as many R's as you are given. If you are given two R's, then you would add together _____ R's.

46.

Solve these formulas. Use your metric number table.

1. $R_T = R_1 + R_2 + R_3 + R_4 + \cdots$; $R_1 = 5K$, $R_2 = .4M$

   R_T = _____

2. $E = IR$; $I = 3m$, $R = 3K$

   E = _____

70.

$$\frac{1}{4} + \frac{1}{2} + \frac{1}{3}$$

The first step to solving this problem would be to find a _____ denominator.

19a.

two

46a.

1. R_T = 405,000

Solution:

$R_T = R_1 + R_2 + R_3 + R_4 + \cdots$

$R_T = 5K + .4M$

$R_T = 5000 + 400,000$

$R_T = 405,000$

2. E = 9

Solution:

E = 1R

E = 3m x 3K

E = .003 x 3000 E = 9

70a.

common

20.

Solve this problem:

$R_T = R_1 + R_2 + R_3 + R_4 + \cdots$; $R_1 = 1{,}000$, $R_2 = 5{,}000$, $R_3 = 3{,}500$

46b.

If you missed either of the problems in the last step, solve this problem. If you did not miss them, skip this problem.

$$I = \frac{E}{R} \text{ ; } E = 4K, R = 5$$

I = _____

71.

$$\frac{1}{4} + \frac{1}{6} + \frac{1}{8} = \frac{?}{24} + \frac{?}{24} + \frac{?}{24}$$

4, 6, and 8 will all divide 24. Therefore, 24 can be the common denominator for these fractions.

A common denominator is a number that can be _____ by all the denominators.

20a.

$R_T = 9500$

Solution:

$R_T = 1000 + 5000 + 3500$

$R_T = 9500$

46c.

$I = 800$

Solution:

$$I = \frac{E}{R}$$

$$I = \frac{4K}{5}$$

$$I = \frac{4000}{5}$$

$$I = 800$$

71a.

divided

21.

We often use METRIC numbers in a formula. The following steps will teach you how to use _____ numbers.

47.

See if you can answer these questions, from memory.

M stands for _____

K stands for _____

m stands for _____

μ stands for _____

n stands for _____

p stands for _____

72.

Find a common denominator for each of these problems. Try to find the lowest one possible.

1. 1/4 + 1/6 common denominator = _____

2. 1/8 + 1/2 common denominator = _____

3. 1/3 + 1/5 + 1/6 common denominator = _____

21a.

metric

47a.

(M) 1,000,000 (one million)

(K) 1,000 (one thousand)

(m) .001 (one thousandth)

(μ) .000001 (five 0's)

(n) .000000001 (eight 0's)

(p) .000000000001 (eleven 0's)

72a.

1. 12 is the lowest common denominator
   (other common denominators are 24, 36, etc.)

2. 8 is the lowest common denominator
   (other common denominators are 16, 24, etc.)

3. 30 is the lowest common denominator
   (other common denominators are 60, 90, etc.)

22.

5m

This is a METRIC number. Very large numbers (such as 3,500,000) are often reported as metric numbers. Very small numbers (such as .000000000003) are also often reported as _____.

47b.

If you missed any of the problems on the last step, do them again here. YOU MUST KNOW THESE VALUES. If you did not miss them, go on to the next step.

M = _____

K = _____

m = _____

μ = _____

n = _____

p = _____

73.

A fraction has two parts, a numerator and a denominator. If you multiply (or divide) both numerator and denominator by a given number, the result is an equivalent fraction. $\frac{3}{7}$ and $\frac{6}{14}$ are _____ fractions.

NOTE: This is NOT TRUE for addition and subtraction. Thus, $\frac{2}{5}$ and $\frac{2+2}{5+2}$ are not equivalent fractions.

22a.

metric numbers

47c.

M = 1,000,000 (one million)

K = 1,000 (one thousand)

m = .001 (one thousandth)

μ = .000001 (five 0's)

n = .000000001 (eight 0's)

p = .000000000001 (eleven 0's)

73a.

equivalent

23.

There are many ways to write "five million." You can write "5,000,000," but that's a lot of 0's. You can write "5 million," but that's still pretty long. Suppose we abbreviate "million" to "M." Then we can write 5_____.

48.

Below, we have written the metric symbols out of sequence. See if you can write the correct value for each one, from memory.

K stands for _____

p stands for _____

m stands for _____

M stands for _____

μ stands for _____

n stands for _____

74.

If you multiply the denominator by 5, you must multiply the numerator by 5. If you multiply the denominator by 16, you must multiply the numerator by _____.

23a.

M

48a.

(K) 1,000 (one thousand)

(p) .000000000001 (eleven 0's)

(m) .001 (one thousandth)

(M) 1,000,000 (one million)

(μ) .000001 (five 0's)

(n) .000000001 (eight 0's)

74a.

16

24.

You can change 3,000,000 to 3M as long as you remember that "M" means one _____.

48b.

If you missed <u>any</u> of the problems on the last step, do them again here. Otherwise, skip this step.

m = _____

K = _____

P = _____

M = _____

μ = _____

n = _____

75.

Circle all pairs of equivalent fractions.

$\frac{1}{5}, \frac{6}{30}$ $\frac{1}{2}, \frac{1}{4}$ $\frac{7}{8}, \frac{15}{16}$ $\frac{2}{3}, \frac{6}{9}$

24a.

million

48c.

m = .001 (one thousandth)

K = 1,000 (one thousand)

p = .000000000001 (eleven 0's)

M = 1,000,000 (one million)

μ = .000001 (five 0's)

n = .000000001 (eight 0's)

75a.

$\frac{1}{5}, \frac{6}{30}$ $\frac{2}{3}, \frac{6}{9}$

25.

Let "M" stand for one million. Abbreviate these numbers.

4,000,000 = _____

7,000,000 = _____

16,000,000 = _____

49.

Solve this problem.

$I = \frac{E}{R}$; $E = 5K$, $R = 50$

I = _____

76.

Figure out the numerators.

$\frac{1}{2} = \frac{\quad}{6}$ $\frac{1}{4} = \frac{\quad}{8}$ $\frac{1}{6} = \frac{\quad}{30}$

25a.

4M

7M

16M

49a.

I = 100

Solution:

$$I = \frac{E}{R}$$

$$I = \frac{5K}{50}$$

$$I = \frac{5000}{50}$$

$$I = 100$$

76a.

$$\frac{3}{6} \qquad \frac{2}{8} \qquad \frac{5}{30}$$

26.

Let "K" stand for 1000. Abbreviate these numbers.

7,000 = _____

4,000 = _____

161,000 = _____

50.

Solve this problem without help.

$R_T = R_1 + R_2$; $R_1 = 7K$, $R_2 = 89$

R_T = _____

77.

The common denominator is 12. Change each numerator.

$$\frac{1}{6} + \frac{1}{3} + \frac{1}{4} = \frac{\quad}{12} + \frac{\quad}{12} + \frac{\quad}{12}$$

26a.

7K

4K

161K

50a.

R_T =7,089

Solution:

$R_T = R_1 + R_2$

$R_T = 7K + 89$

$R_T = 7{,}000 + 89$

$R_T = 7{,}089$

77a.

$$\frac{2}{12} + \frac{4}{12} + \frac{3}{12}$$

27.

IR

↑

MULTIPLY

You know that "no symbol" means to _____. What does the lack of symbols below mean?

3K	5m	1.9M
↑	↑	↑
_____	_____	_____

51.

Solve this formula without help.

E = IR; I = 2m, R = 17K

E = _____

78.

Example

$C = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots;\ R_1 = 5,\ R_2 = 6$

$C = \frac{1}{5} + \frac{1}{6}$

$C = \frac{6}{30} + \frac{5}{30}$

$C = \frac{11}{30}$

Problem

$C = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots;\ R_1 = 2,\ R_2 = 3$

C = _____

27a.

multiply

multiply

multiply

multiply

51a.

E = 34

Solution:

E = IR

E = 2m x 17K

E = .002 x 17,000

E = 34

78a.

$C = \frac{5}{6}$

Solution:

$C = \frac{1}{2} + \frac{1}{3}$

$C = \frac{3}{6} + \frac{2}{6}$

$C = \frac{5}{6}$

28.

M = 1,000,000 K = 1000 m = .001

When you see 5M, you know that it means 5 multiplied by 1,000,000. When you see 13K, you know that it means 13 _____ by 1000. When you see 7m, you know that it means *_____.

52.

Solve this problem without help.

$$R = \frac{E}{I} \; ; \; E = 14, \; I = 7m$$

R = _____

END OF TEXT

28a.

multiplied

*7 multiplied by .001

NOTE: TURN BACK TO PAGE 1 WHERE YOU WILL FIND STEP NUMBER 29.

52a.

R = 2,000

Solution:

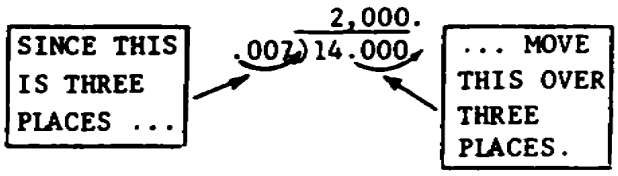
$$R = \frac{E}{I}$$

$$R = \frac{14}{7m}$$

$$R = \frac{14}{.007} *$$

$$R = 2000$$

*NOTE: Here is how you divide by a decimal fraction and get the decimal point in the correct position.



NOTE: TURN BACK TO PAGE 1 WHERE YOU WILL FIND STEP NUMBER 53.

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